CLAIMS

1. A film-coated powder having a coating film on the surface of substrate particles, which has spectrophotometric characteristic in that, when the ratio of the length at 400 nm between 380 and 780 nm on measuring the reflection spectrum from the vertical reflection light of the film-coated powder (wavelength definition width L) to the height of the reflectance 100 % in the vertical axis (reflectance definition width R), L/R is 5/2, then the ratio of the peak height (H) to the half-value width (W), H/W is at least 1.

2. The film-coated powder according to claim 1, wherein the coating film comprises two or more layers.

3. The multi-layer film-coated powder according to claim 1, wherein the coating film comprises two or more layers having a different refractive index, and

the thickness of each layer of the coating film is so designed that the reflection intensity R (λ) of the multi-layer film-coated powder, as corrected in point of the shape and the particle size thereof from the reflection intensity $R_{flat}$ of the multi-layer film of the corresponding multi-layer film-coated flat specifically selected in point of the material of the substrate particles, the number of the coating layers, the

coating order of the coating layers, the material of the coating layers and the desired reflected light wavelength, may be the maximum value or the minimum value at a desired wavelength.

4. The multi-layer film-coated powder according to claim 3, wherein the thickness of each layer of the coating film is so designed that the R(λ) value may be the maximum value or the minimum value at a desired wavelength when the matters based on the material of the substrate particles, the number of the coating layers, the coating order of the coating layers, the material of the coating layers and the desired reflected light wavelength all specifically selected herein are introduced into the following recurrence formula (1) to give the multi-layer film reflection intensity,

$$R_{j+1,j} = \frac{r_{j+1,j} + R_{j,j-1}\exp(-2i\delta_j)}{1 + r_{j+1,j}R_{j,j-1}\exp(-2i\delta_j)} \qquad (1)$$

$$2\delta_j = \frac{4\pi}{\lambda} n_j d_j \cos\phi_j$$

wherein $R_{j+1,j}$ indicates the amplitude reflection intensity between the j-th layer from the bottom and the layer just above it;

j indicates an integer of 1 or more (j - 1 = 0 indicates the substrate);

i indicates an imaginary unit;

$r_{j+1,j}$ indicates the Fresnel reflectance coefficient of the interface between the j-th layer from the bottom and the layer just above it;

$R_{j,j-1}$ indicates the amplitude reflection intensity between the (j-1)th layer from the bottom and the layer just above it;

$2\delta_j$ indicates the phase difference at the j-th layer from the bottom,

$\lambda$ indicates the desired reflected light wavelength;

$n_j$ indicates the refractive index of the j-th layer from the bottom;

$d_j$ indicates the thickness of the j-th layer from the bottom;

$\phi j$ indicates the light incident angle into the j-th layer from the bottom,

and the resulting $R_{flat}$ value is further applied to the following equation (2):

$$R(\lambda) = \int_0^{\frac{\pi}{2}} \sin 2\theta \cdot R_{flat}(\lambda, \theta) \cdot d\theta \qquad (2)$$

wherein $\theta$ indicates the incident angle into the outermost layer, to thereby take the shape-dependent correction of the value into consideration for the film thickness.

5. The multi-layer film-coated powder according to claim 3, wherein the thickness of each layer of the coating film is determined by coating the selected substrate particles with the

selected multiple coating layers with stepwise varying the thickness of the layers in some types to give a film-coated powder for particle size correction, then measuring the actual film thickness ($d_M$) of each coating layer of the film-coated powder, analyzing the film-coated powder with a spectrometer to obtain the optical film thickness (nd) of each coating layer of the film-coated powder, computing the ratio, $nd/nd_M$, of the optical thickness (nd) of each coating layer to the product ($nd_M$) of the actually-measured film thickness of each coating layer of the film-coated powder and the refractive index thereof (n), and

multiplying the ratio $nd/nd_M$ by $2\delta_j$ in the following recurrence formula (1) to give the multi-layer film reflection intensity,

$$R_{j+1,j} = \frac{r_{j+1,j} + R_{j,j-1}\exp(-2i\delta_j)}{1 + r_{j+1,j}R_{j,j-1}\exp(-2i\delta_j)}$$

$$2\delta_j = \frac{4\pi}{\lambda} n_j d_j \cos\phi_j \qquad (1)$$

wherein $R_{j+1,j}$ indicates the amplitude reflection intensity between the j-th layer from the bottom and the layer just above it;

j indicates an integer of 1 or more (j - 1 = 0 indicates the substrate);

i indicates an imaginary unit;

$r_{j+1,j}$ indicates the Fresnel reflectance coefficient of the interface between the j-th layer from the bottom and the layer just above it;

$R_{j,j-1}$ indicates the amplitude reflection intensity between the (j-1)th layer from the bottom and the layer just above it;

$2\delta_j$ indicates the phase difference at the j-th layer from the bottom,

$\lambda$ indicates the desired reflected light wavelength;

$n_j$ indicates the refractive index of the j-th layer from the bottom;

$d_j$ indicates the thickness of the j-th layer from the bottom;

$\phi j$ indicates the light incident angle into the j-th layer from the bottom,

to obtain the intended film thickness as corrected in point of the spectral characteristics of the multi-layer film-coated powder.

6. The multi-layer film-coated powder according to claim 5, wherein the measurement of the actual film thickness ($d_M$) of each coating layer of the film-coated powder for particle size correction is attained by cutting each particle of the powder and analyzing the cut face thereof.

7. The multi-layer film-coated powder according to claim 6, wherein the film-coated particles for particle size correction are cut by processing them with focused ion beams.

8. A coating composition which comprises the film-coated powder according to claim 1.

9. A coated material formed by applying the coating composition according to claim 8.

10. A multi-layer film-coated powder, which comprises at least two coating layers having a different refractive index on the substrate particles thereof and which reflects light having a specific wavelength,

wherein the thickness of each layer of the coating film is so designed that the reflection intensity R ($\lambda$) of the multi-layer film-coated powder, as corrected in point of the shape and the particle size thereof from the reflection intensity $R_{flat}$ of the multi-layer film of the corresponding multi-layer film-coated flat specifically selected in point of the material of the substrate particles, the number of the coating layers, the coating order of the coating layers, the material of the coating layers and the desired reflected light wavelength, may be the maximum value or the minimum value at a desired wavelength.

11. The multi-layer film-coated powder according to claim 10, wherein the thickness of each layer of the coating film is so designed that the $R(\lambda)$ value may be the maximum value or the minimum value at a desired wavelength when the matters based on the material of the substrate particles, the number of the coating layers, the coating order of the coating layers, the material of the coating layers and the desired reflected light wavelength all specifically selected herein are introduced into the following recurrence formula (1) to give the multi-layer film reflection intensity,

$$R_{j+1,j} = \frac{r_{j+1,j} + R_{j,j-1}\exp(-2i\delta_j)}{1 + r_{j+1,j}R_{j,j-1}\exp(-2i\delta_j)}$$

$$2\delta_j = \frac{4\pi}{\lambda} n_j d_j \cos\phi_j \qquad (1)$$

wherein $R_{j+1,j}$ indicates the amplitude reflection intensity between the j-th layer from the bottom and the layer just above it;

j indicates an integer of 1 or more ($j - 1 = 0$ indicates the substrate);

i indicates an imaginary unit;

$r_{j+1,j}$ indicates the Fresnel reflectance coefficient of the interface between the j-th layer from the bottom and the layer just above it;

$R_{j,j-1}$ indicates the amplitude reflection intensity between the (j-1)th layer from the bottom and the layer just above it;

$2\delta_j$ indicates the phase difference at the j-th layer from the bottom,

$\lambda$ indicates the desired reflected light wavelength;

$n_j$ indicates the refractive index of the j-th layer from the bottom;

$d_j$ indicates the thickness of the j-th layer from the bottom;

$\phi j$ indicates the light incident angle into the j-th layer from the bottom,

and the resulting $R_{flat}$ value is further applied to the following equation (2):

$$R(\lambda) = \int_0^{\frac{\pi}{2}} \sin 2\theta \cdot R_{flat}(\lambda,\theta) \cdot d\theta \qquad (2)$$

wherein $\theta$ indicates the incident angle into the outermost layer, to thereby take the shape-dependent correction of the value into consideration for the film thickness.

12. The multi-layer film-coated powder according to claim 10, wherein the thickness of each layer of the coating film is determined by coating the selected substrate particles with the selected multiple coating layers with stepwise varying the thickness of the layers in some types to give a film-coated powder for particle size correction, then measuring the actual

film thickness ($d_M$) of each coating layer of the film-coated powder, analyzing the film-coated powder with a spectrometer to obtain the optical film thickness (nd) of each coating layer of the film-coated powder, computing the ratio, $nd/nd_M$, of the optical thickness (nd) of each coating layer to the product ($nd_M$) of the actually-measured film thickness of each coating layer of the film-coated powder and the refractive index thereof (n), and

multiplying the ratio $nd/nd_M$ by $2\delta_j$ in the following recurrence formula (1) to give the multi-layer film reflection intensity,

$$R_{j+1,j} = \frac{r_{j+1,j} + R_{j,j-1}\exp(-2i\delta_j)}{1 + r_{j+1,j}R_{j,j-1}\exp(-2i\delta_j)}$$

$$2\delta_j = \frac{4\pi}{\lambda} n_j d_j \cos\phi_j \qquad (1)$$

wherein $R_{j+1,j}$ indicates the amplitude reflection intensity between the j-th layer from the bottom and the layer just above it;

j indicates an integer of 1 or more (j - 1 = 0 indicates the substrate);

i indicates an imaginary unit;

$r_{j+1,j}$ indicates the Fresnel reflectance coefficient of the interface between the j-th layer from the bottom and the layer

just above it;

$R_{j,j-1}$ indicates the amplitude reflection intensity between the (j-1)th layer from the bottom and the layer just above it;

$2\delta_j$ indicates the phase difference at the j-th layer from the bottom,

$\lambda$ indicates the desired reflected light wavelength;

$n_j$ indicates the refractive index of the j-th layer from the bottom;

$d_j$ indicates the thickness of the j-th layer from the bottom;

$\phi j$ indicates the light incident angle into the j-th layer from the bottom,

to obtain the intended film thickness as corrected in point of the spectral characteristics of the multi-layer film-coated powder.

13. The multi-layer film-coated powder according to claim 12, wherein the measurement the actual film thickness ($d_M$) of each coating layer of the film-coated powder for particle size correction is attained by cutting each particle of the powder and analyzing the cut face thereof.

14. The multi-layer film-coated powder according to claim 13, wherein the film-coated particles for particle size correction are cut by processing them with focused ion beams.

15. A method for producing a multi-layer film-coated powder, which comprises at least two coating layers having a different refractive index on the substrate particles thereof and which reflects light having a specific wavelength,

wherein the thickness of each layer of the coating film is so determined that the reflection intensity R ($\lambda$) of the multi-layer film-coated powder, as corrected in point of the shape and the particle size thereof from the reflection intensity $R_{flat}$ of the multi-layer film of the corresponding multi-layer film-coated flat specifically selected in point of the material of the substrate particles, the number of the coating layers, the coating order of the coating layers, the material of the coating layers and the desired reflected light wavelength, may be the maximum value or the minimum value at a desired wavelength, and the intended powder is produced so that it may have the thus-determined film thickness.

16. A method for producing the multi-layer film-coated powder according to claim 2, wherein the thickness of each layer of the coating film is so determined that the reflection intensity R ($\lambda$) of the multi-layer film-coated powder, as corrected in point of the shape and the particle size thereof from the reflection intensity $R_{flat}$ of the multi-layer film of the corresponding multi-layer film-coated flat specifically selected in point of the material of the substrate particles,

the number of the coating layers, the coating order of the coating layers, the material of the coating layers and the desired reflected light wavelength, may be the maximum value or the minimum value at a desired wavelength, and the intended powder is produced so that it may have the thus-determined film thickness.

17. The method for producing a multi-layer film-coated powder according to claim 15 or 16, wherein the thickness of each layer of the coating film is so designed that the R(λ) value may be the maximum value or the minimum value at a desired wavelength when the matters based on the material of the substrate particles, the number of the coating layers, the coating order of the coating layers, the material of the coating layers and the desired reflected light wavelength all specifically selected herein are introduced into the following recurrence formula (1) to give the multi-layer film reflection intensity,

$$R_{j+1,j} = \frac{r_{j+1,j} + R_{j,j-1}\exp(-2i\delta_j)}{1 + r_{j+1,j}R_{j,j-1}\exp(-2i\delta_j)}$$

$$2\delta_j = \frac{4\pi}{\lambda} n_j d_j \cos\phi_j \qquad (1)$$

wherein $R_{j+1,j}$ indicates the amplitude reflection intensity between the j-th layer from the bottom and the layer

just above it;

j indicates an integer of 1 or more ($j - 1 = 0$ indicates the substrate);

i indicates an imaginary unit;

$r_{j+1,j}$ indicates the Fresnel reflectance coefficient of the interface between the j-th layer from the bottom and the layer just above it;

$R_{j,j-1}$ indicates the amplitude reflection intensity between the (j-1)th layer from the bottom and the layer just above it;

$2\delta_j$ indicates the phase difference at the j-th layer from the bottom,

$\lambda$ indicates the desired reflected light wavelength;

$n_j$ indicates the refractive index of the j-th layer from the bottom;

$d_j$ indicates the thickness of the j-th layer from the bottom;

$\phi j$ indicates the light incident angle into the j-th layer from the bottom,

and the resulting $R_{flat}$ value is further applied to the following equation (2):

$$R(\lambda) = \int_0^{\frac{\pi}{2}} \sin 2\theta \cdot R_{flat}(\lambda,\theta) \cdot d\theta \qquad (2)$$

wherein $\theta$ indicates the incident angle into the outermost layer, to thereby attain the shape-dependent correction of the value for the film thickness.

18. The method for producing a multi-layer film-coated powder according to claim 15 or 16, wherein the thickness of each layer of the coating film is determined by coating the selected substrate particles with the selected multiple coating layers with stepwise varying the thickness of the layers in some types to give a film-coated powder for particle size correction, then measuring the actual film thickness ($d_M$) of each coating layer of the film-coated powder, analyzing the film-coated powder with a spectrometer to obtain the optical film thickness (nd) of each coating layer of the film-coated powder, computing the ratio, $nd/nd_M$, of the optical thickness (nd) of each coating layer to the product ($nd_M$) of the actually-measured film thickness of each coating layer of the film-coated powder and the refractive index thereof (n), and

multiplying the ratio $nd/nd_M$ by $2\delta_j$ in the following recurrence formula (1) to give the multi-layer film reflection intensity,

$$R_{j+1,j} = \frac{r_{j+1,j} + R_{j,j-1}\exp(-2i\delta_j)}{1 + r_{j+1,j}R_{j,j-1}\exp(-2i\delta_j)}$$

$$2\delta_j = \frac{4\pi}{\lambda} n_j d_j \cos\phi_j \qquad (1)$$

wherein $R_{j+1,j}$ indicates the amplitude reflection intensity between the j-th layer from the bottom and the layer just above it;

j indicates an integer of 1 or more ($j - 1 = 0$ indicates the substrate);

i indicates an imaginary unit;

$r_{j+1,j}$ indicates the Fresnel reflectance coefficient of the interface between the j-th layer from the bottom and the layer just above it;

$R_{j,j-1}$ indicates the amplitude reflection intensity between the (j-1)th layer from the bottom and the layer just above it;

$2\delta_j$ indicates the phase difference at the j-th layer from the bottom,

$\lambda$ indicates the desired reflected light wavelength;

$n_j$ indicates the refractive index of the j-th layer from the bottom;

$d_j$ indicates the thickness of the j-th layer from the bottom;

$\phi j$ indicates the light incident angle into the j-th layer from the bottom,

to correct the spectral characteristics of the powder having the coating layers for the substrate particle size-dependent correction of the value for the film thickness, and forming the coating layers so that they may have the thus-corrected spectral characteristics.

19. The method for producing a multi-layer film-coated powder according to claim 18, wherein the measurement the actual film thickness ($d_M$) of each coating layer of the film-coated powder for particle size correction is attained by cutting each particle of the powder and analyzing the cut face thereof.

20. The method for producing a multi-layer film-coated powder according to claim 19, wherein the film-coated particles for particle size correction are cut by processing them with focused ion beams.